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ABSTRACT

The ability to understand and frame problems encountered in practice is a critical skill for school leaders. This paper reports on a study that inquired about the teaching and learning of problem-framing skills in the Prospective Principals Program at Stanford University, a preparation program for school administrators that relies on problem-based learning (PBL) strategies for 40 percent of the curriculum. A literature-based definition of problem-framing ability is developed, and a theoretical rationale for the study is introduced. Incorporating the use of a quasi-experimental study design, the program-framing skills in three successive student cohorts, with graduated levels of exposure to the PBL, are assessed. Analysis reveals that all three cohorts differ significantly in problem-framing ability, associated with their level of exposure to PBL. Qualitative data, collected through a series of student interviews, support the quantitative findings. Problem-based learning experiences are instrumental for developing prospective principals' ability to frame problems in practice. Finally, the paper discusses the implications of the findings for instructional practice and explores ideas for possible future research on the use of problem-based learning in administrator preparation. An appendix contains Subskills in Problem Framing Ability. (Contains 41 references.) (Author/DFR)

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Developing the Problem-framing Skills of Prospective Principals

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Abstract

The ability to understand and frame encountered problems in practice is a critical skill for school leaders. This paper reports on a study that inquired about the teaching and learning of problem-framing skills in the Prospective Principals Program at Stanford University, a preparation program for school administrators that relies on problem-based learning (PBL) strategies for 40% of the curriculum. A literature-based definition of problem-framing ability is developed, and a theoretical rationale for the study is introduced. Incorporating the use of a quasi-experimental study design, the problem-framing skills of three successive student cohorts, with graduated levels of exposure to PBL, are assessed. An ANCOVA analysis reveals that all three cohorts differ significantly in problem-framing ability, associated with their level of exposure to PBL. Qualitative data, collected via a series of student interviews, supports the quantitative findings. The results suggest that problem-based learning experiences are instrumental for developing prospective principals' ability to frame problems in practice. Finally, the paper discusses the implications of the findings for instructional practice and explores ideas for possible future research on the use of problem-based learning in administrator preparation.

Criticisms levied at the preparation of educational administrators during the mid-to-late 1980's yielded several institutional responses, comprising alternatives to conventional curricular and instructional practices in the field (c.f., Bridges with Hallinger, 1992; Milstein, 1993; Murphy, 1992; Murphy, 1993; Osterman & Kottkamp, 1993). Many of these reform efforts incorporate a pedagogical shift from faculty-centered to student-centered approaches that more actively involve prospective administrators in the learning process (McCarthy, 1999). These approaches, as McCarthy (1999) notes:

> encourage the use of inductive, problem-based strategies that are grounded in adult learning theory and the reality of schools (c.f., Bridges, 1992; Hallinger & McCary, 1991; Mulford, 1985; Murphy, 1992; Shibles, 1988)

In some instances, new-fashioned approaches to preparation have relied upon a contextualized view of the thinking and learning process, often termed situated cognition, in which knowledge is created and made meaningful by the context and activities through which it is acquired (Prestine and LeGrand, 1991).

One such alternative approach for preparing school leaders, problem-based learning (PBL), originated in medical education and is conceived of as a method of instruction and an approach to building a curriculum that employs complex, interdisciplinary problems taken from professional practice

as the starting point for learning (Bridges with Hallinger, 1992). PBL places students in the role of the school administrator through the use of contextualized problem scenarios, wherein they must work with others to understand and solve problems associated with school leadership.

The research reported in this paper employs a conceptual framework rooted in theories of cognition and social-psychology to support an inquiry into the teaching and learning of problem-framing ability in a problem-based administrator preparation program. Specifically, the study tests the hypothesis that greater exposure to problem-based preparation experiences is associated with greater problem-framing ability among prospective principals.

LEADERSHIP, PROBLEM-SOLVING AND PBL

Scholars within the field of educational leadership have suggested that because of the highly contingent nature of school leadership, a focus on improving the quality of administrators' problem-solving is likely to be more productive in preparing principals than a focus on teaching specific actions or behaviors (Leithwood & Steinbach, 1992). This direction for preparation seems appropriate, given the complexity of dilemmas encountered in the modern principalship, and the vast array of snarls that are present in leading a school. Successful principals must be skilled in the ability to understand, formulate, and solve problems.

As Achilles & Hoover (1996) note elsewhere, a number of scholars have illustrate differences in the nature of

problems and the ways they are encountered. Getzels (1979, 1986) differentiated between presented problems, those with a known formulation, and discovered or created problems, those that must be formulated or invented by the problem-solver. Similarly, Wagner (1993) distinguished between academic and practical problems. Perhaps most usefully for the purpose of this study, Leithwood (1995) differentiated between routine, well-structured problems, and ill-structured, non-routine problems. School administrators regularly encounter problems in their work environment that are both routine and non-routine.

Problem-based learning specifically intends to familiarize prospective principals with various types of problems they will face in their future roles, and to develop skills of understanding and solving problems (Bridges with Hallinger, 1992). Given these intentions, knowledge about learning outcomes in the area of problem-solving resulting from experience with problem-based learning has a high degree of relevance for the field. However, limited empirical evidence exists at present regarding any outcomes associated with problem-based preparation in educational administration. This study examines one intended outcome of problem-based preparation, an aspect of prospective principals' problem-solving skill, the ability to understand and frame problems.

PROBLEM-FRAMING ABILITY

Clinical reasoning in medicine, as well as problem-solving behavior in educational administration, can be

characterized as a creative process in response to a problematic situation in which the initial *framing* of the problem is fundamental to the development of a useful solution. John Dewey (1910) noted that "the essence of critical thinking is suspended judgment; and the essence of this suspense is inquiry to determine the nature of the problem before proceeding to attempts at its solution." Dewey uses the example of a medical doctor's diagnosis of a patient's ailment. He notes:

> Imagine a doctor is called in to prescribe for a patient. The patient tells him some things that are wrong; his experienced eye, at a glance, takes in other signs of a certain disease. But if he permits the suggestion of this special disease to take possession prematurely of his mind, to become an accepted conclusion, his scientific thinking is by that much cut short. A large part of his technique, as a skilled practitioner, is to prevent the acceptance of the first suggestions that arise; even, to postpone the occurrence of any very definite suggestion till the trouble -- the nature of the problem -- has been thoroughly explored (Dewey, 1910, pg. 74).

The conception of an initial definition of the problem is widely supported, and perhaps by none more eloquently than Jacob W. Getzels (Getzels, 1979; Getzels & Csikszentmihalyi, 1976). Getzels studied the creative process in visual artists

and refers to the initial formulation of a problem as "problem-finding" ability. Getzels found that a person who has learned to be concerned with problem-finding will not approach a problem situation with a ready-made solution in mind. A skilled problem-finder will not let past experience completely determine what is to be done; rather, he or she will let the new challenge suggest new solutions.

The research reported herein focused only on students' initial understanding and formulation of encountered problems. Within the field of medicine, the comparable first step is the formation of a *diagnosis* which does not specify treatment. Specifically, this preliminary aspect of problem-solving skill is defined here as being consistent with Cuban's (1990) notion of problem-framing ability. Cuban notes:

> Framing a problem, then, is a subjective process. It depends upon one or more facts that show a discrepancy between what is and what ought to be. It depends upon the perceptions of the person or group who interpret the data and do the defining. What shapes (these perceptions) are (one's) previous personal and work experiences, (one's) beliefs and values, the position (one holds) within an organization, and the expected role (one) is to play within that organization. (Cuban, 1990, pg. 2)

Bolman and Deal (1993) point out that problem-framing is no easy task in the modern organization, and the manner in

which a problem is framed determines the script that ultimately guides action. They note:

> Leaders in particular are required to make sense of ambiguous, complex, and puzzling events. When they frame accurately and respond appropriately, puzzles and problems become promising opportunities. When frames distort or overlook essential elements of a situation, leaders "lose the bubble," feel out of control, and fall back on familiar scripts even if their actions only make things worse. (Bolman and Deal, 1993, pg. 23)

They go on to suggest that the leader's ability to reframe a problem involves a conscious effort to size up a situation using multiple lenses (pg. 24). Bolman and Deal view the ability to reframe complex problems as an important precondition to the effective exercise of leadership.

As one product of the problem-solving research done by Leithwood and various colleagues, Leithwood and Stager (1989) developed a theoretical model comprised of six grounded components that were identified in school principals problem-solving processes. For each of these six categories, Leithwood et al. identified a more specific set of subskills associated with the behavior, as well as performance indicators that differentiate between "expert" and "novice" problem-solvers.

An analysis of the Leithwood and Stager (1989) framework, suggests that a number of these various subskills

focus directly on abilities or processes employed in the initial formulation or framing of administrative problems, that are consistent with the skills of problem-framing taught in problem-based learning. For example, from Leithwood et al., expert principals (a) have an understanding of the importance of developing a clear interpretation of a problem, (b) have the ability to develop a clear interpretation of the problem and the ability to describe this interpretation to others, (c) seek out and take into account the interpretation others have of the problem, (d) carefully check their own assumptions relative to others' interpretation of problems, (e) have less of a personal stake in any preconceived solution than non-experts, (f) anticipate obstacles likely to arise during group problem solving, and (g) plan in advance for how to address anticipated obstacles.

Larry Cuban (1990) highlights another critical subtask inherent to the problem-framing process. Cuban notes that problems encountered by principals in practice frequently have solutions already embedded in them. Leaders often commit the fatal error of strongly embracing a preconceived solution before a problem has been clearly defined and understood. This suggests that an additional important step in problem-framing is the principal's ability to recognize a problem that has been presented with a predetermined solution, and then to reframe the problem in solution-free terms. Different and equally sound solutions to a problem may exist, particularly with regard to non-routine, complex

dilemmas. By developing a clear understanding and definition of a problem situation, the principal creates the frame in which all viable solutions can be considered. Indeed, the way a problem is framed fundamentally determines whether a predetermined solution will quickly follow, or other alternative solutions will be considered. Appendix A provides a rubric of these subskills that serves as a definition of problem-framing ability for the purposes of this research.

PROBLEM-FRAMING ABILITY IN PRACTICE

An illustrative example may help to clarify how these subskills act in concert in the problem-framing process. In framing a problem, one must first understand the problem as presented. School administrators encounter problems that reside at various levels within a school organization. The way a problem is initially presented frequently reflects the particular bias or understanding of the individual or group who has raised the issue.

Imagine a situation in which a teacher approaches the principal with a complaint about a particular student's behavior in class, and demands that the student be removed and placed in another class. Initially, it is important for the principal to understand that the teacher sees the problem as residing with the student.

Consistent with this understanding, a principal employing expert skills in problem framing would recognize that the teacher has framed the problem with a preconceived solution, and this recognition would trigger a reflective

process, however brief. From the teacher's point of view, the appropriate solution, already embedded, is to move the student into another class. A skilled principal would understand that the way the problem is presented lends itself to only one solution, and would endeavor to look deeper into the nature of this problem in order formulate a clear, unbiased interpretation.

The principal may have some personal views about the teacher's interactions with students based upon previous encounters of this type. This knowledge might raise some assumptions that need to be checked against the facts in this particular case. An expert principal will not overlook the possibility that the way the teacher has framed the problem may be absolutely correct, but also will be careful to use what he or she knows in reflecting on the situation.

Given the recognition that a pre-determined solution has been presented in the situation, the principal might choose to reframe the problem in such a way that various other useful solutions could be considered. Rather than placing the blame on the student or on the teacher, the principal might search for alternative ways of framing the situation. The principal may rely on an established problem-solving process for working through the situation -- collecting more information, collaborating with support staff who may have insights into the situation, or considering other lenses on the problem. For example, the complainant may be a teacher who has never experienced this kind of difficulty with a

student, or this may be a teacher who has a history of many of these types of encounters. The student in question may have a long record of behavioral difficulties that limit the options available. Or, the student may have no previous record of problems in the classroom.

Depending on the situation, the expert principal would anticipate obstacles that are likely to arise from various solution alternatives. Taking a full account of the facts in the situation would enable the skillful principal to look ahead and figure out how the obstacles can be addressed should they arise.

While this simplistic example does not do justice to the intricate interrelatedness of the various subskills in problem-framing, it is offered to provide a sense of the thought processes a principal skilled in framing problems might use when encountering such a situation on the job. In practice, this process would obviously occur rapidly and naturally for a principal who possessed a high degree of facility in this area.

THEORETICAL FRAMEWORK

The conceptual warrant for inquiring about a relationship between problem-based instruction and student's ability to understand and frame problems of practice can be established several ways. Bridges (1992) developed a rationale for the use of problem-based learning in the preparation of educational administrators grounded in three different conceptual areas - theories of cognition,

motivation, and function. A brief review of the cognitive perspective is included here, as it is most clearly suggestive of a link between problem-based learning experiences and students' acquisition of problem-framing skills. The discussion of the cognitive rationale is followed by the introduction of a second theoretical perspective drawn from social psychology which further supports the inquiry.

Bridges (1992), drawing on the work done in medical education by Schmidt (1983), notes three conditions created within a problem-based learning environment that information theory links to subsequent retrieval and appropriate use of new information: activation of prior knowledge, encoding of knowledge in a specific context, and opportunity to elaborate on that information.

First, in problem-based learning *prior knowledge is activated.* Students are expected to exercise knowledge they already possess in order to understand the problem situation they face. Bridges (1992, p. 9) notes that "this prior knowledge and the kind of cognitive structure in which it is stored determine what is understood from the new experience and what is learned."

Second, in PBL *new knowledge is encoded in a context modeled on practice.* Research on cognition suggests that knowledge is more likely to be remembered or recalled in the context in which it was originally learned (Godden and Baddeley, 1975). As Bridges notes (1992, p.9) "encoding

specificity in problem-based learning is achieved by having students acquire knowledge in a functional context, that is, in a context containing problems that closely resemble the problems they will encounter later on in their professional careers."

Third, PBL offers students the *opportunity to elaborate on information* that is learned. Elaboration provides redundancy in memory, which in turn reduces forgetting and abets retrieval (Bridges, 1992, p.9). One might expect that the skills of problem-framing are better understood, processed and recalled through strategies such as small group discussion, peer review of ideas about how particular information applies to a given problem, and the practice of reflecting back on problem-solving processes through debriefing practices and personal essays of what was learned.

In addition to the cognitive rationale outlined above, social psychological theory also provides conceptual support for an inquiry into links between modes of instruction and the learning of various skills. Social comparison theory (Festinger, 1954) posits that humans have an innate need to evaluate their own abilities with those of similar others. Given that students in the preparation program entered with the common intention to pursue a career in school leadership, one might expect comparisons of abilities central to that work to be prevalent. Furthermore, Rosenholtz and Simpson (1984) suggest that classrooms which are organized to recognize and promote multiple performance dimensions will

provide multiple bases for students to compare and evaluate their abilities.

Designers of problem-based learning implicitly recognize that social comparison of ability is prevalent and central to students' appraisal of self and others. This is evident in the incorporation of performance-based assessments, assignment of various roles to students in the problem-solving process, emphasis on the practice of a variety of "real world" skills important for the work of the principal, including the framing of administrative problems, and in the open, often public, nature of the feedback processes used in PBL. One might expect greater opportunities for ability comparison and self-evaluation to result in stronger ability within students.

METHODOLOGY

Subjects

The subjects included in this study were eighteen students enrolled in the Stanford University Prospective Principals Program. The specific students included in the study comprise three cohorts admitted to the program in successive years (n=six students per cohort). An extensive set of background data, including age, gender, ethnicity, GRE scores, years of teaching experience, and level of prior education, was collected on each student prior to beginning the study. The nature and use of the background measures is introduced in the analysis.

Study Design

Assessment of students' problem-framing ability was accomplished through the use of a quasi-experimental, post-test only design (Cook & Campbell, 1979). Given the university setting, and the cyclical nature of turnover in the Prospective Principals Program, the study is further categorized as a cohort design in a formal institution with cyclical turnover (Cook et al., pg. 126). Cook and Campbell note that cohorts are useful for experimental purposes because (a) some cohorts receive a particular treatment while preceding or following cohorts do not, and (b) it is often reasonable to assume that a cohort differs only in minor ways from its contiguous cohorts (pg. 127).

The purpose of the design was to test whether the three successive PPP cohorts differed in their problem-framing ability. The cohorts were tested after receiving different levels of exposure to problem-based learning. A schematic representation of the study design, including grand mean scores of each cohort, is presented in Table 1.

<Insert Table 1 here>

Each of the eighteen subjects was individually presented with a series of five short, written administrative problem scenarios that were developed specifically for the purpose of this study. All represented actual problems that were faced in practice by a school principal. While not explicitly known by the subjects, each scenario featured an embedded solution as part of the problem formulation. Students were asked to

respond in writing to each of the following questions about each problem scenario:

1. How has the problem been defined in this scenario?
2. Employing what you know and believe about solving problems in practice, reflect on how this problem has been framed. Be as thorough as possible.
3. If faced with this situation in practice, would you reframe the problem? If so, how? (If you choose to restate the problem, justify your reasons for doing so.)

Cohort 1 (first-year group), completed the exercise prior to participation in any problem-based learning experience, nor any program exposure to the concept of problem-framing. Cohort 2 (second year group) completed the assessment during their second summer in the problem-based practicum, after exposure to approximately seven (7) PBL projects; Cohort 3, during their final summer in the program, after exposure to approximately twelve (12) PBL experiences.

All three groups completed the scenario exercises under similar conditions. Students responded in writing to the five scenarios, in a consistent order, during one sitting in the same university classroom. Students were given little instruction about the exercise other than to read each scenario and respond in writing to the three questions. Students were not allowed to discuss their responses to the scenarios until after all materials had been turned in by all students. Responses were collected in a manner that insured a blind scoring process.

Measurement

The subskills of problem-framing included ten indicators, in three categories, and formed the basis for construction of a scoring instrument used in assessing responses to the problem scenarios.[1] Three (3) independent raters assessed student responses to the three questions using the ten item scoring instrument. All three raters had experience as principals, and one rater was not connected to students nor to the preparation program in any way. All responses were scored blind. All raters scored each subject's written responses on a 0-3 scale (0 = no evidence of indicator; 3 = strong-compelling evidence of indicator) corresponding to each indicator.

Reliability and Validity

The reliability of the measure used to assess the prospective principals' problem-framing ability was analyzed using generalizability (G) theory, a statistical theory about the dependability of behavioral measurements (Shavelson & Webb, 1991). To briefly summarize, the G study examined variablity in scoring due to persons (*p*), raters (*r*) and scenarios (*s*), and all possible combinations of those three factors. This type of analysis enables one to determine the sources of variability within the measure, their relative magnitudes, as well as the overall reliability (generalizability) of the measure. It was revealed that, as expected, differences between persons (subjects) accounted for a relatively high magnitude of the variance in scores,

approximately 44%. Magnitude of variability due to raters was comparatively very small (2%), as was variability across the five problem scenarios (0%). Furthermore, the generalizability coefficient generated for the measure, across raters, scenarios, and subjects, was on the order of .89, indicating the measure was highly reliable.

Of particular interest for the purposes of this study is the content validity of the problem scenarios. Content validity concerns the extent to which the items employed adequately sample the domain or concept of interest; it examines whether the items are representative of the domain of interest. Ideally, content validity should be established deductively "by defining a universe of items and sampling systematically within this universe to establish the test" (Cronbach & Meehl, 1955, p. 282). Such is not always the case, however, particularly in social science research when definition of a universe of content is difficult. Instead, the case for content validity is made inductively here, based upon information regarding the construction of the problem scenarios.

Consistent with the work of Wigdor and Green (1991), the content validity of the problem scenarios was assessed along two axes: *abstractness*, and *fidelity* of the measure. The *abstractness* of the measure assessed the likelihood that a principal might actually confront the problems detailed in the measure. A highly concrete measure, in this case, would include highly relevant problems, such as those a school

administrator might reasonably expect to encounter in practice. The more abstract the measure, the less it would appear to approximate an actual administrative problem. The *fidelity* of the measures is defined as an assessment of the extent to which the measure, as encountered by the students in the study, mirrors the real-world situation of interest. A high fidelity problem scenario would closely replicate the manner in which an administrator encounters it in practice.

The problem scenarios used in the study were developed by the researcher from actual experiences encountered by school administrators, including three problem scenarios encountered in practice by the researcher himself, one scenario encountered by a colleague, and one scenario adapted from a set of materials developed by a national principal's organization (NASSP). Moreover, while each problem was presented in a specific context, the underlying nature of the problems cut across geographic, experiential and grade level boundaries. The issues included an interpersonal conflict among staff members, a classroom management situation, a racially-charged school site council decision, a situation involving a district-level curricular adoption, and a freedom of speech issue. Each represents a concrete domain of interest for prospective school administrators and, while not exhaustive of all the domains, are representative of those commonly encountered. That two outside analysts, each with experience as principal, found the measure to be "face valid"

further supports this claim. Abstractness of the measure, therefore, was assessed to be relatively low.

The open-ended nature of the questions that students answered about each scenario more closely approximated reality than, for example, choosing from a list of pre-determined responses in multiple-choice format. Students formulated their own unique responses to each scenario. Whether the formulation of a response culminates in verbal or written discourse may be less important. If anything, the process of writing provided students an opportunity for additional mental rehearsal of their responses, and may thereby strengthen the responses. Given this, it was determined that the measure was of moderate fidelity. A method of measurement with higher fidelity, perhaps involving role players or some other manner of face-to-face interaction rather than a pencil and paper exercise, would have proven difficult to convene given the constraints of the testing situation. This said, the fidelity of the problem scenarios was recognized as a limitation in the study design.

Qualitative Data Collection

In addition to the quantitative study, a series of interviews were conducted with all eighteen students. While the interview protocol focused primarily on another aspect of the study not reported here, aspects of the interviews were used to elicit feedback from students regarding the development of their administrative abilities. Some student responses related information about their development of

problem-solving skills. These data provide a secondary focus in the analysis and a few illustrative student comments are included in this paper as a means for triangulating with the results found in the quantitative study of problem-framing ability.

ANALYSIS

To attack the problem of separating the effect of the treatment from the possible effects of selection differences, a two-step statistical analysis was conducted. First, a correlation matrix was created to determine the nature of the relationships between a number of background measures and the dependent variable, problem-framing ability. A composite background measure found to be highly correlated with the dependent variable was identified for use as a covariate in further statistical analysis. Second, an analysis of covariance (ANCOVA) was conducted to assess differences between cohort groups on problem-framing ability, employing the composite background measure as a covariate. Detailed explanation in each area follows.

Correlation

In order to determine the nature of the relationships between available background measures and the dependent variable, a correlation matrix was calculated that included age, gender, ethnicity, GRE scores (verbal, quantitative and analytic, and a composite GRE variable -- GREAQ), years of education-related work experience, subjects' level of prior education, as well as each subjects' grand mean of problem-

framing scores. The correlation matrix is presented as Table 2.

<Insert Table 2 here>

Scores on all three of the GRE subtests (verbal, quantitative and analytic) had a significant positive correlation with the dependent variable, problem-framing ability (.5085, .6918 and .6145, respectively). The quantitative and analytic subtests were most highly correlated with problem-framing ability (alpha <.01). A new variable, called GREAQ, was created by summing subjects' scores from these two tests. GREAQ was also highly correlated with the dependent variable (.6895, significant at alpha < .01). Subjects' gender also showed a moderate negative correlation with the dependent variable (-.4678, alpha < .05). However, this significant correlation can be explained by the fact that all the subjects with no exposure to problem-based learning were female. Differences in the problem-framing scores between males and females with some level of exposure to PBL were not significant.

Analysis of Covariance

Subjects' responses on the five problem-framing scenarios were scored by three independent raters, using the ten item scoring instrument. A grand mean score, across all items (10), scenarios (5) and raters (3), was calculated for each subject. This grand mean represents the closest approximation available to a "true" score for each subject's problem-framing ability, as measured by the instrument. Given

that the generalizability analysis was conducted on the complete design (persons x raters x scenarios), and reliability of the measure was established at the level of the grand mean, the analysis of the dependent variable was appropriately conducted at that same level.

An analysis of covariance (ANCOVA) was calculated on subjects' grand mean of problem-framing scores by cohort. ANCOVA uses a covariate, an individual difference variable which is highly correlated with the dependent measure, as a statistical control to reduce unexplained error variation. To do this, in ANCOVA the dependent variable is adjusted statistically to remove the effects of error variation represented by predictable differences within groups -- variation due to the covariate (Ruiz-Primo, Mitchell, and Shavelson, 1996). Given the small *n*, and the fact that, for each covariate employed in the ANCOVA one degree of freedom is lost from the error term, a decision was made to include only one covariate, GREAQ, in the model.

The research hypothesis proposed that the ability to frame administrative problems is greater among prospective principals with more exposure to problem-based learning than for those who have had less exposure. The ANCOVA summary table is presented as Table 3. Two rows in the ANCOVA table,

<Insert Table 3 here>

Main Effects and *Explained*, can be ignored. The former summarizes the combined main effects; the latter summarizes all systematic effects in the study. The remaining rows in

the ANCOVA table include the main effect for Cohort (length of exposure to PBL), the effect for the covariate GREAQ, the error term (*residual*), and a row summarizing the total of all sources of variation.

A significant main effect was found for Cohort ($F<.000$), representing the levels of exposure to problem-based learning. This result indicates that significant mean differences were present among the cohort groups on the dependent variable, problem-framing ability. Second, it is important to note that the error term (*residual*) was reduced by more than half as compared to a simple one-way ANOVA without the covariate.[2] Finally, as expected, the covariate F value was significant (Sig of $F=.002$).

To summarize, the ANCOVA provides support for the research hypothesis, concluded that significant differences among treatment group means were found. However, which group means differ significantly cannot be determined from the initial ANCOVA table. Post hoc comparisons of the adjusted group means were conducted to make this determination.

Post Hoc Comparisons of Adjusted Means

The significant main effect revealed in the ANCOVA is based on comparison of the adjusted Cohort means for the dependent variable. In order to conduct post hoc comparisons between groups, Cohort means were statistically adjusted to remove the effect of the covariate.[3] It was expected in the study design that Cohort 3, the group with the most exposure to problem-based learning, would score higher on the problem-

framing measure than Cohort 2, the group with the next highest level of exposure to PBL. Also, it was expected that both Cohort 3 and Cohort 2 would score higher than Cohort 1, which had no exposure to PBL. The expected pairwise relationships were formulated as three separate null hypotheses, using the adjusted means for each cohort. In order to test these specific hypotheses, and to determine which (if any) of the observed differences were due to chance, Tukey's HSD test was used to conduct the pairwise comparisons.[4]

All three pairwise comparisons revealed significant differences between groups on the dependent variable, problem-framing ability. The difference in the adjusted means between Cohort 3, those students with the greatest exposure to problem-based learning, and Cohort 1, those students with no exposure, was significant at alpha < .01. The difference between the adjusted means for Cohort 2 and Cohort 1 was also significant at alpha < .01. The comparison between Cohorts 3 and 2, who had received graduated levels of exposure to PBL, revealed a significant difference at the .05 level of alpha for greater exposure to PBL.

Qualitative Findings

Analysis of qualitative data collected via student interviews provided insights about how students viewed aspects of their personal problem-solving ability, and how this ability had developed. First year students were interviewed toward the end of their first summer in the

administrator preparation program; second year students during their second summer; and third year students near the conclusion of their preparation experience. Fourteen of eighteen students stressed aspects of problem-solving ability as a personal strength compared with others in the field of educational administration. This was particularly true of responses from students in the second and third year cohorts. All of the fourteen who noted problem-solving skills as a personal strength attributed the development of these skills, at least in part, to their preparation in problem-based learning. One third year student offered this assessment of how his entire cohort had grown in their ability to frame and solve problems over the course of their experience in the PPP:

> I think in terms of skills, we're far more adept than we were at the beginning of the program at the... problem-solving process. As well as the, sort of, perspectives that we bring to the problems. I think that the program has taught us to consider more broadly, the issues that might impact a decision that we make. Or the impact that our decisions might make, as we're designing solutions. And I think that...that's pretty dramatic, right across the board. That people have.... internalized the need to think broadly in terms of the....constituencies that you need to take into account as you're making decisions. In a way that we didn't right off the

bat. [Student #6285: Text Unit 120]

A second year student remarked:

> (I'm better at) working through problems because of the (PBL) practicum, again. Rather than feeling overwhelmed, looking at it....(so) that there's a way to break it down and to work through it. Which is something that's been so intimidating before...Before it was like "Oh my God, we've got this huge problem and what are we going to do." And everybody's kind of frustrated together. But, to actually have a process that you can work through. [Student #2002: Text Unit 71]

Another second year student provided an example of how problem-framing skills, learned and practiced in the PPP practicum, impacted his understanding of decision-making processes observed at work:

> I sat down in meetings last year with (organization for whom he worked) where....(person's name), who founded the organization came in and said, "Okay.....We need to change our selection model." In other words, how we select people. (The leader said) "What do you guys think? How should we do that?" So....there were ten people sitting around the table saying, "Well, we should do this. We should do that. We should do this." And I raised my hand and said, "That all sounds great, but what is the problem? What exactly is the problem?" And I think that

> that's the question that I kept pushing on people all year, to the point where I think they were frustrated with me, because I was questioning just about everything we did. But what I sensed was people always getting around the table with their own set of criteria...the reasons why they think this is a good answer, but no common agreement on what the problem was. And so....I was constantly pushing people to spend the time....analyzing what the problem was. [Student #1029: Text Unit 8]

DISCUSSION

The quantitative analysis presented two challenges, one that resided outside of the control of the researcher, and one that was statistically controlled. With regard to the former, given the small *n* of each cohort group, only large effects sizes would register as statistically significant differences between groups. The smaller the sample, after all, the greater the chance that more subtle effects are masked in the analysis; this is the fundamental problem of using parametric statistics with small samples. The use of non-parametric statistics for analysis was considered initially but then set aside, predicated on the tenuous expectation that large effects existed which, if found, would be suggestive of greater practical significance. Had the ANCOVA returned a non-significant result, a non-parametric analysis would have been entertained as a backup look at the data.

Secondly, a composite background variable was identified that was highly correlated with the dependent variable. Without removing the effect of the correlated variable, a finding of statistically significant differences between groups opens the door to alternative interpretations; for example, that the exercise was really measuring differences in cohort GRE, rather than differences in problem-framing ability. However, the inclusion of the correlated variable as a covariate in the statistical model increases the power of the statistical analysis (Light, et al., 1990), statistically removing the influence of highly correlated GRE scores on variances in the dependent variable.

The results suggest that, within this particular preparation setting, greater exposure to problem-based learning is associated with greater problem-framing ability among students. Qualitative data collected in student interviews corroborates this finding. Common sense, as well as scholarship in the field of educational administration (c.f., Hallinger, Leithwood and Murphy, 1993), suggests the strong need for principals to be able to understand, frame and solve problems they encounter in practice. To date, evidence about the impact of the strategies encompassed by problem-based learning on the development of associated leadership skills has been thin. The case for using PBL in educational administration has been made primarily through the study of PBL in medical education; however, research into the relationship between medical education models of problem-

based learning and students' problem-solving ability is characterized by unsystematic study and equivocal evidence. As Leithwood et al. (1993) point out in discussing a future research agenda involving problem-based learning in the preparation of school leaders, educational administration "cannot rely on extrapolations from weak evidence, collected outside the field, for instructional guidelines" (Leithwood, Hallinger and Murphy, pg. 277). While the results found in this study of PBL are tempered by various limitations, addressed in the next section, the findings also appear to merit a discussion of implications for instructional practice and curricular planning in educational administration.

Limitations

Methodological limitations include the unique character of the sample. The unusual nature of the student population in the PPP, and the intentionally intimate structure of the program also constrain one's ability to generalize to other populations. These constraints were identified as limiting factors early in the process of conceptualizing the study. The presence of these factors detracts from the generalizability of the findings, even though the instrument used to measure problem-framing ability was found to be highly reliable.

Lack of random assignment to groups also limits the interpretation of the results. Successive cohorts admitted to the PPP go through an identically rigorous admission process, and have many similar characteristics, as the exploration of

several background characteristics revealed. However, there are undoubtedly other background characteristics not examined here that may have introduced selection bias not accounted for in the analysis. Though one can make the case that the use of the ANCOVA is more precise than a statistical procedure that ignores differences in background measures altogether, it is still likely to be biased. The sameness of the cohorts cannot be unequivocally determined on the basis of the selected background measures alone. Nonetheless, the use of the ANCOVA model rests on this tenuous assumption, and therefore tempers the findings.

One might also question to what extent the findings can be attributed to factors other than exposure to problem-based learning that influenced students' ability to "think like an administrator" over time. Were forces other than PBL at work in students' environments in or out of preparation that inculcate this kind of thinking? Students in the second and third summers of the administrator preparation program may have benefited from increased exposure to problems in the workplace that they encountered during the intervening academic years working as teachers, and the accompanying opportunities to practice problem-framing skills learned during that time. If this occurred, and if so, how it occurred, is not known and therefore leaves open an alternative explanation for the findings.

Finally, as noted previously, the fidelity of the problem scenarios was judged to be moderate. While the

content was highly concrete and germane to the work of school administration, the manner in which the problem scenarios were encountered was, in fact, different from the usual ways problems are encountered in practice, and so raises questions about their validity.

Implications for Curriculum Development and Instructional Practice

Limitations notwithstanding, the results of the study suggest that under particular conditions, an important prerequisite of administrators' problem-solving ability, the framing of administrative problems, can be successfully taught and developed in students during the process of preparing for the principalship. While global generalizations about the efficacy of problem-based learning are not appropriate given the nature of the study design, a discussion of the preparation setting and use of problem-based learning may be useful to those concerned with teaching problem-framing skills to prospective principals.

First, the application of problem-based learning in the Prospective Principals Program accounts for 40% of a total administrator preparation curriculum. That curriculum also features a series of core courses, specifically designed for principal preparation, as well as a particular set of field experience projects. Together with the problem-based practicum, these three program components play out over the course of three consecutive summers of study, and two intervening school years.

Second, the study highlights a specific version of PBL, and the processes used by instructors within that version. While literatures from various fields are rife with interpretations and uses of the term "problem-based learning," Bridges' (with Hallinger, 1992) version of PBL offers some clarity regarding background and rationale, choice of content, structure and sequencing of projects, the role of the instructor, and other specific aspects that pertain to the preparation of school leaders.

Third, as suggested in the conceptual framework, instructional practices that activate prior knowledge and situate learning in contexts similar to those that will be encountered in practice appear to foster the development of students' ability to understand and frame problems. Moreover, the incorporation of debriefing techniques that encourage students' elaboration of knowledge and reflection on learning may help solidify a way of thinking about problems.

Finally, the qualitative findings suggest that social comparison processes appear to be a factor in shaping and developing students' skills and abilities. The research further suggests that careful sequencing of skill-based expectations through increasingly complex and diverse problem-solving experiences may be a useful technique for building student skills in problem-framing. Additionally, by focusing on global skills (management and organization of meetings, problem framing, written communication, oral

communication, time management, etc.) early in preparation, students may develop a useful tool kit for approaching ever more complex problem situations later on.

Implications for Future Research

The results of this research effort provide initial evidence, in one specific skill area, with one group of students, of the efficacy of a specific method of problem-based learning for teaching problem-framing skills to prospective principals. The findings signal a potentially rich research agenda focused on the study of associated outcomes of problem-based preparation. Two possibilities for future research stemming from this study are discussed in the paragraphs that follow.

First, a followup study that examines the development of problem-framing ability within a PBL setting across time, within in one group of students, would provide an opportunity to test the findings from this study. Rather than employing a quasi-experimental design to compare "snapshots" of problem-framing ability across three cohorts, a longitudinal study employing a test-retest design would enable comparisons to be made within the same subjects. In fact, a follow-up examination of the first year PPP cohort is planned, to reassess their problem-framing skills at or near the end of their final (third) year in the PPP. These data would provide one means for assessing the development of problem-framing ability over time.

The findings also raise the question of whether problem-framing ability associated with problem-based preparation actually transfers into the early practice of school administration. As Bridges and Hallinger (1993) suggest, researchers may find it fruitful to examine the extent to which graduates of PBL-based programs spontaneously use the general problem-solving strategies they acquired during their training. Given the findings on problem-framing ability, one might use qualitative methods to examine the use of that specific skill in the work practice of new school principals, who had apprenticed in a problem-based learning environment.

NOTES

[1] As listed in the Appendix, the indicators derive from Leithwood's and colleagues' work on expert-novice problem-solving among school administrators (Leithwood and Stager, 1989), and Cuban's conception of problem-framing skill (Cuban, 1990).

[2] A one-way ANOVA comparing problem-framing scores by cohort revealed a residual (error) term of .769.

[3] The statistical formula for calculating the adjusted means comes from Shavelson (1996, pg. 516).

[4] Tukey's HSD (honestly significant difference) test calculates an observed q value for each comparison, which is measured against a critical q value from a generalized studentized range distribution (c.f., Shavelson, 1996, pg. 518) to determine whether group differences are significant.

References

Achilles, C. M. & Hoover, S. P. (1996). Transforming administrative praxis: The potential for problem-based learning (PBL) as a school improvement vehicle for middle and high schools. Presented paper, American Educational Research Association, New York.

Bolman, L., & Deal, T. (1993). Everyday Epistemology in School Leadership: Patterns and Prospects. In P. Hallinger, K. Leithwood, & J. Murphy (Eds.), *Cognitive Perspectives on Educational Leadership* (pp. 21-33). New York: Teacher's College Press.

Bridges, E. M. (1977). The Nature of Leadership. In L. Cunningham, et al (Ed.), *Educational Administration: The Developing Decades* . Berkeley, CA: McCutchan Publishing Corporation.

Bridges, E. M. with Hallinger, P. (1992). *Problem-based Learning for Administrators*. Eugene, OR: ERIC/CEM.

Bridges, E. M., & Hallinger, P. (1993). Problem-based Learning in Medical and Managerial Education. In P. Hallinger, K. Leithwood, & J. Murphy (Eds.), *Cognitive Perspectives on Educational Leadership* (pp. 253-267). New York: Teacher's College Press.

Bridges, E. M. (in press). *The Use of Cases in Problem Based Learning*. Manuscript in preparation. Stanford University. Stanford, CA.

Bridges, E. M. (1999). Personal conversation, January 30, 1999. Stanford University. Stanford, CA.

Bridges, E. M., & Hallinger, P. (1995). *Implementing Problem-based Learning in Leadership Development*. Eugene, OR: ERIC/CEM.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-Experimentation: Design and Analysis Issues for Field Settings*. Chicago: Rand McNally College Publishing.

Copland, M. A. (1999). *Problem-based Learning, Problem-framing Ability and the Principal Selves of Prospective School Principals*. Doctoral dissertation, Stanford University, Stanford, CA.

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin, 52*, 281-302.

Cuban, L. (1990). *Problem-finding*. Problem-based learning project. Stanford University: School of Education.

Dewey, J. (1910). *How We Think*. Boston: Heath.

Festinger, L. (1954). A Theory of Social Comparison Processes. *Human Relations*, 7, 117-140.

Getzels, J. (1979). Problem-Finding in Research in Educational Administration. In G. L. Immegart & W. Boyd (Eds.), *Problem-finding in Educational Administration* (pp. 5-22). Lexington, MA: D. C. Heath.

Getzels, J., & Csikszentmihalyi, M. (1976). *The Creative Vision: A Longitudinal Study of Problem Finding in Art*. New York: Wiley and Sons.

Godden, D. and Baddeley, A. (1975). Context-Dependent Memory in Two Natural Environments: On Land and Underwater. *British Journal of Psychology, 66*, 325-32.

Good, T. & Brophy, J. (1991). *Looking in Classrooms*. New York,: Harper and Row.

Hallinger, P., Leithwood, K., & Murphy, J. (Eds.). (1993). *Cognitive Perspectives on Educational Administration*. New York, NY: Teachers College Press.

Hallinger, P. & McCary, C. E. (1991). Using a problem based approach for instructional leadership development. *Journal of Staff Development*, 12(2), 6-12.

Leithwood, K., & Hallinger, P. (1993). Cognitive Perspectives on Educational Administration: An Introduction. *Educational Administration Quarterly, 29*(3).

Leithwood, K., Hallinger, P., & Murphy, J. (1993). Conclusion: The expertise of educational leaders. In P. Hallinger, K. Leithwood, & J. Murphy (Eds.), *Cognitive Perspectives on Educational Leadership* (pp. 268-280). New York: Teacher's College Press.

Leithwood, K., & Stager, M. (1989). Expertise in Principal's Problem Solving. *Educational Administration Quarterly, 25*(Number 2 (May 1989)), 126-161.

Leithwood, K. & Steinbach, R. (1995). *Expert problem solving*. Albany, NY: State University of New York Press.

Leithwood, K., & Steinbach, R. (1992). Improving the Problem-solving Expertise of School Administrators: Theory and Practice. *Education and Urban Society, 24*(3), 317-345.

Light, R, Singer, J. & Willet, J. (1990). *By Design: Planning Research on Higher Education*. Cambridge, MA: Harvard University Press.

McCarthy, M. (1999). The Evolution of Educational Leadership Preparation Programs. In J. Murphy & K. Seashore Louis (Eds.) *Handbook of Research on Educational Administration.* San Francisco: Jossey Bass.

Milstein, M. M. (1993). *Changing the way we prepare educational leaders: The Danforth Experience.* Newbury Park, CA: Corwin Press, Inc.

Mulford, B. (1985, August). *Assessing effectiveness in the field of professional preparation programs in educatoinal administration.* Paper presented at international symposium, The Professional Preparation and Development of Educational Administrators in Commonwealth Developing Areas, Barbados.

Murphy, J. (1992). *The landscape of leadership preparation: Reframing the education of school administrators.* Newbury Park, CA: Corwin Press.

Murphy, J. (1993). *Preparing Tomorrow's School Leaders: Alternative Designs.* University Park, PA: University Council for Educational Administration.

Osterman, K. F., & Kottkamp, R. B. (1993). *Reflective Practice for Educators: Improving Schooling Through Professional Development.* Newbury Park, CA: Corwin Press, Inc.

Rosenholtz, S., and Simpson, C. (1984). Classroom Organization and Student Stratification. *The Elementary School Journal.* 85(1), 21-37.

Ruiz-Primo, M. A., Mitchell, M., & Shavelson, R. J. (1996). *Student guide for Shavelson Statistical reasoning for the behavioral sciences.* (Third edition ed.). Boston: Allyn and Bacon.

Schmidt, H. (1983) Problem-Based Learning: Rationale and Description. *Medial Education, 17,* 11-16.

Shavelson, R. J. (1996). *Statistical reasoning for the behavioral sciences.* (Third ed.). Boston, MA: Allyn and Bacon.

Shavelson, R. J., & Webb, N. M. (1991). *Generalizability theory: a primer.* Newbury Park, CA: Sage Publications.

Shibles, M. R. (1988). *School leadership preparation: A preface for action.* Washington, DC: American Association of Colleges for Teacher Preparation.

Wagner, R. K. (1993). Practical problem solving. In P. Hallinger, K. Leithwood, and J. Murphy (Eds.) *Cognitive*

perspectives on educational leadership. New York: Teachers College Press.

Waterman, R., Akmajian, P., & Kearny, S. (1991). *Community-Oriented Problem-Based Learning at the University of New Mexico*. Albuquerque, New Mexico: University of New Mexico School of Medicine, 1991.

Wigdor, A., & Green, B. (Eds.). (1991). *Performance Assessment for the Workplace. Vol. 1*. Washington, D. C.: National Academy Press.

APPENDIX A

Subskills in Problem Framing Ability

(I) Definition of the stated problem.

Descriptor:

- Clear recognition of the stated problem.

(II) Reflection on the stated problem.

Descriptors:

- Identification of the importance of formulating a clear interpretation of the problem prior to considering possible solutions.
- Identification of the importance of approaching a problem without holding to a preconceived solution.
- Raising and checking personal assumptions about the problem situation.
- Consideration of the views of others in the problem situation.
- Identification of pre-existing solution(s) embedded in the initial problem situation.

(III) Reframing of the problem (if necessary).

Descriptors:

- Restatement of the problem in solution-free terms.
- Identification and reliance on personal values related to a problem-solving process in restating the problem.
- Anticipation of obstacles likely to arise during the problem-solving process.
- Anticipation of ways to address obstacles should they arise.

TABLE 1
Quasi-experimental Design:
Descriptive Statistics - Cohort by Grand Mean of Problem-framing Ability

Variable	*GrandMean*	*SD*	*Variance*	*Cases*
Cohort 1.00 *(First year cohort- No exposure to PBL)*	1.0067	.1247	.0156	6
Cohort 2.00 *(Second year cohort- 1+ year exposure to PBL)*	1.7500	.2286	.0522	6
Cohort 3.00 *(Third year cohort- 2+ years exposure to PBL)*	2.2100	.2463	.0607	6
Entire Population	1.6556	.5459	.2980	18

TA

Correlation of Background Vari

	PROBFRAM	*AGE*	*ETHNIC*	*GENDER*	*GREA*	
PROBFRAM	1.000	-.047	-.466	**-.496***	**.615****	
AGE		1.000	-.048	-.114	-.150	-
ETHNIC			1.0000	.1754	-.1714	-
GENDER				1.0000	-.4187	-
GREA					1.0000	
GREQ						1
GREV						
GREAQ						
TEACHEXP						
PREVMA						

* - Signif. LE .05 ** - Signif. LE .01 (2-tail

ABLE 2
iables and Problem-Framing Ability

GREQ	*GREV*	*GREAQ*	*TEACHEXP*	*PREVMA*
.692**	**.5085***	**.6895****	.0095	.3571
.199	-.0559	-.1836	.8683**	.3464
.4202	-.5336*	-.3115	-.1498	-.2686
.5812*	-.4669	-.5275*	-.0432	-.3223
.7931**	.7289**	.9476**	-.0815	-.2362
.0000	.7945**	.9462**	-.2077	.1304
	1.0000	.8042**	-.0337	-.0487
		1.0000	-.1523	-.0571
			1.0000	.2806
				1.0000

ed)

TABLE 3
Analysis of Covariance Summary Table
Problem-framing Ability by Cohort with Covariate GREAQ

Source	*Sum of Squares*	*df*	*Mean Square*	*fRatio*	*Sig of f*
Main Effects	4.908	3	1.636	62.040	.000
COHORT	2.399	2	1.199	45.486	.000
GREAQ (Covar)	.401	1	.401	15.218	.002
Explained	4.908	3	1.636	62.040	.000
Residual	.369	14	.026		
Total	5.277	17	.310		

EXPERIMENTAL sums of squares
Covariates entered WITH main effects